CLAIMS

1. An estimating apparatus of the amount of optical distortion of light transmitted through a transparent plate member with unevenness of refractive power of the transparent plate member, comprising:

means for irradiating a grid pattern having an array of a bright portion and a dark portion with a constant pitch and a constant width;

means for picking-up said grid pattern by using an image pickup device;

means for inputting a signal from said image pickup device, as gray image data;

means for supporting and conveying said transparent plate member in an optical line ranging from said grid pattern to said image pickup device; and

image processing means for processing the gray image data inputted from said image pickup device,

wherein, upon picking-up the image of the grid pattern on said image pickup device, $Xn \pm \alpha$ CCD pixels correspond to n grids, thereby generating α moire fringes, and

said image processing means comprises:

means for calculating a plurality of types of sine waves deviated in phase at 90° from image data of said moire fringes;

means for obtaining a phase angle at each pixel based on said plurality of types of sine waves; and

means for calculating refractive power of the optical distortion based on the difference in phase angles between the pixels.

2. An estimating apparatus of the amount of optical distortion of light reflected to a glossy plate member with unevenness of surface smoothness of the plate member, comprising

means for irradiating a grid pattern having an array of a bright portion and a dark portion with a constant pitch and a constant width;

means for picking-up a reflected image of said grid pattern by using an image pickup device;

means for inputting a signal from said image pickup device, as gray

image data;

means for supporting and conveying the glossy plate member so that light from said grid pattern is reflected to the plate member and is incident on said image pickup device;

image processing means for processing the gray image data inputted from said image pickup device,

wherein, upon picking-up the image of the grid pattern on said image pickup device, $Xn \pm \alpha$ CCD pixels correspond to n grids, thereby generating α moire fringes, and

said image processing means comprises:

means for calculating a plurality of types of sine waves deviated in phase at 90° from image data on said moire fringes;

means for obtaining a phase angle at each pixel based on said plurality of types of sine waves; and

means for calculating the amount of deviation of the reflected light based on the difference in phase angles between the pixels.

3. An estimating apparatus of the optical distortion according to Claim 1 or 2, wherein said X satisfies $X=4p$ (where p is an integer of 1 or more).

4. An estimating method of the amount of optical distortion of light transmitted through a transparent plate member with unevenness of refractive power of the transparent plate member, comprising:

a step of picking-up an image of a grid pattern having an array having a bright portion and a dark portion with a constant pitch and a constant width by using an image pickup device and enabling $Xn \pm \alpha$ CCD pixels to correspond to n grids, thereby generating α moire fringes, upon picking-up the image of the grid pattern on said image pickup device, and

a step of processing, by image processing means, gray image data of the grid pattern picked-up by said image pickup device via said transparent plate member,

wherein said step of processing by the image processing means comprises:

a step of calculating a plurality of types of sine waves deviated in phase at 90° from image data on said moire fringes;

a step of obtaining a phase angle at each pixel based on said plurality of types of sine waves; and

a step of calculating refractive power of the optical distortion based on the difference in phase angles between the pixels.

5. An estimating method of the amount of optical distortion of light reflected to a glossy plate member with unevenness of surface smoothness of the plate member, comprising:

a step of picking-up an image reflected, on the glossy plate member, of a grid pattern having an array having a bright portion and a dark portion with a constant pitch and a constant width by using an image pickup device and enabling $Xn \pm \alpha$ CCD pixels to correspond to n grids, thereby generating α moire fringes, upon picking-up the image of the grid pattern on said image pickup device, and

a step of processing, by image processing means, gray image data of the reflected image of the grid pattern picked-up by said image pickup device,

wherein said step of processing by the image processing means comprises:

a step of calculating a plurality of types of sine waves deviated in phase at 90° from image data of said moire fringes;

a step of obtaining a phase angle at each pixel based on said plurality of types of sine waves; and

a step of calculating the amount of deviation of the reflected light based on the difference in phase angles between the pixels.

6. An estimating method of the optical distortion according to Claim 4 or 5, wherein said X satisfies $X=4p$ (where p is an integer of 1 or more).

7. A detecting apparatus of a chipped portion having the optical distortion of a transparent plate member, comprising:

means for irradiating a grid pattern having an array of a bright portion and a dark portion with a constant pitch and a constant width;

means for picking-up the grid pattern by using an image pickup device;

means for inputting a signal from said image pickup device, as gray image data;

means for supporting and conveying the transparent plate member in an optical path ranging from the grid pattern to said image pickup device; and

image processing means for processing the gray image data inputted from said image pickup device,

wherein α moire fringes are generated by the correspondence of $Xn \pm \alpha$ CCD pixels to n grids upon picking-up the grid pattern to said image pickup device, and

said image processing means comprises:

means for calculating a plurality of types sine waves deviated in phase at 90° from image data of said moire fringes;

means for obtaining a phase angle at each pixel from the plurality of types of sine waves; and

means for detecting the chipped portion having the optical distortion based on the difference in phase angle between the pixels.

8. A detecting apparatus of a chipped portion having the optical distortion of a surface of a glossy plate member, comprising:

means for irradiating a grid pattern with an array of a bright portion and a dark portion with a constant pitch and a constant width;

means for picking-up a reflected image of the grid pattern by using an image pickup device;

means for inputting a signal from said image pickup device, as gray image data;

means for supporting and conveying the plate member so that light from the grid pattern is reflected to the glossy plate member and is incident on said image pickup device; and

image pickup means for processing the gray image data inputted from said image pickup device,

wherein α moire fringes are generated by the correspondence of

Xn±α CCD pixels to n grids upon picking-up the grid pattern to said image pickup device, and

said image processing means comprises:

means for calculating a plurality of types sine waves deviated in phase at 90° from image data of said moire fringes;

means for obtaining a phase angle at each pixel from the plurality of types of sine waves; and

means for detecting the chipped portion having the optical distortion based on the difference in phase angle between the pixels.

9. A detecting apparatus of a chipped portion having the optical distortion according to Claim 7 or 8, wherein said X satisfies X=4p (where p is an integer of 1 or more).

10. A detecting method of a chipped portion having the optical distortion of a transparent plate member, comprising:

a step of picking-up an image of a grid pattern having an array having a bright portion and a dark portion with a constant pitch and a constant width and generating α moire fringes by the correspondence of Xn+α CCD pixels to n grids, upon picking-up the image of the grid pattern on said image pickup device; and

a step of processing, by image processing means, gray image data of the grid pattern picked-up by said image pickup device via the transparent plate member,

wherein said step of processing by the image processing means comprises:

a step of calculating a plurality of types of sine waves deviated in phase at 90° from image data of said moire fringes;

a step of obtaining a phase angle at each pixel based on said plurality of types of sine waves; and

a step of detecting the defect having the optical distortion based on the difference in phase angles between the pixels.

11. A detecting method of a chipped portion having the optical distortion of a surface of a glossy plate member, comprising:

a step of picking-up an image reflected, on the glossy plate member,

of a grid pattern having an array of a bright portion and a dark portion with a constant pitch and a constant width and generating α moire fringes by the correspondence of $Xn \pm \alpha$ CCD pixels to n grids, upon picking-up the reflected image of the grid pattern on said image pickup device; and

a step of processing, by image processing means, gray image data of the reflected image of the grid pattern picked-up by said image pickup device,

wherein said step of processing by said image processing means comprises:

a step of calculating a plurality of types of sine waves deviated in phase by 90° from image data of said moire fringes;

a step of obtaining a phase angle at each pixel based on said plurality of types of sine waves; and

a step of detecting the chipped portion having the optical distortion based on the difference in phase angle between the pixels.

12. A detecting method of a chipped portion having the optical distortion according to Claim 10 or 11, wherein said X satisfies $X=4p$ (where p is an integer of 1 or more).